WEST Search History

DATE: Tuesday, July 09, 2002

Set Name side by side	**Query**	**Hit Count**	**Set Name** result set
DB=USPT; PLUR=YES; OP=ADJ			
L28	L23 and transceiv$	0	L28
L27	L23 and transc$	11	L27
L26	L23 and internet	0	L26
L25	teller-eric.in.	0	L25
L24	teller.in. and ((600/$)!.CCLS.)	0	L24
L23	L21 and L22	53	L23
L22	(((600/$)!.CCLS.))	34036	L22
L21	heat flux	4442	L21
DB=USPT,PGPB,EPAB,DWPI; PLUR=YES; OP=ADJ			
L20	L18 not implant$ and ((600/549)!.CCLS.)	24	L20
L19	L18 not implant$	424	L19
L18	(Thermocouple or thermopile) same skin	477	L18
L17	(Thermocouple or thermopile) and skin	2633	L17
L16	HFR and ((600/$)!.CCLS.)	1	L16
L15	L12 and (galvanic skin response or GSR or skin conductance or accelerometer)	1	L15
L14	L13 and (galvanic skin response or GSR or skin conductance or accelerometer)	0	L14
L13	L12 and (GSR)	0	L13
L12	vest and (thermopile or heat flow or heat flux)	38	L12
L11	vest and thermopile	0	L11
L10	L9 and vest	2	L10
L9	thermocouple and (skin conductance or GSR or galvanic skin response)	15	L9
L8	L7 and (accelerometer or body movement)	1	L8
L7	l6 and skin	41	L7
L6	thermopile and heat (flow or flux)	340	L6
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L5	thermopile and ((600/549)!.CCLS.)	61	L5
L4	L3 and (GSR or galvanic skin)	0	L4
L3	thermopile and ((600/$)!.CCLS.)	116	L3
L2	((heat flow or heat flux) sensor) and skin	16	L2

L1	(heat flow or heat flux) and skin	1171	L1

END OF SEARCH HISTORY

Laboratory for Applied Biotelemetry & Biotechnology

Find the word you are looking for in the key word listing below. If a term does not appear in the key word listing, click on EDIT in your browser toolbar, and select FIND (on This Page)... to search for the term within the text on this glossary page. You may have to open the glossary text page in a new window to perform such a search. Open glossary in new window.

This glossary is not intended to be an Encyclopedia of Reference terms. Instead, we intend to give visitors to our web-site the opportunity to quickly read up on terms used on our site they might be unfamiliar with. Therefore, we do not make any claims for complete accuracy of the definitions listed here. While we make every effort to be as accurate as possible, these definitions are intended to be helpful within the context of this web-site.

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A | Acceleration | Accelerometer | Accuracy | Ampere | Angular | Angular Error | Archival Tag | Argos | Azimuth |

B | Bearing | Bearing Error | BIA - Bioelectric Impedance Analysis | Bilirubin | Biotelemetry | Blood | Body Composition | Body Condition | Body Mass | Bootstrap | Buffy Coat |

C | Candela | Capacitive | Casting | CBC Complete Blood Count | Close-range Convergent Three-dimensional Photogrammetry | Conductance | Conductive Heat Flux | Conductivity | Constraint Lines | Convective Heat Flux | Coulomb | Course | Current |

D | Depth | Direction | Drag | Drag Coefficient |

E | ECG - Electro-Cardio-Gram | Electrical Conductivity | Electric Current | Electric Potential | Epoxy | Erythrocytes | Esophagus | Estimated Location |

F | Farad | Fix | Fix Error | Frequency | Force |

G | g Value | Geolocation | GPS - Global Positioning System | Gravitation, Gravity |

H | Heart-rate | Heat Conduction | Heat Convection | Heat Flux | Heat Flux Sensor | Heat Loss | Heat Radiation | Heat Transfer | Hematocrit | Hemoglobin | Hertz | Hydrodynamic Drag | Hydrostatic Pressure | Hysteresis |

I | Impedance | Impeller | Interbearing Angle |

J | Joule |

K | Kelvin | Kilogram |

L | Leukocytes | Life history | Life tables | Linearity | Lymphocytes |

M | Magnetic Declination | Magnetic North | Map Object | Mass | MCH | MCHC | MCV | Meter / Metre | Metric Prefixes | MLE | Maximum Likelihood Estimator | Mole / Mol | Monte-Carlo Simulation | Myoglobin |

N | Newton | North |

O | Oesophagus | Ohm |

P | Packed Cell Volume (PCV) | Pascal | Photogrammetry | Piezo-electric Effect | Piezo-Resistive | Plasma | Platelets | Plethysmograph | Precision | Poly-Urethane | Pressure | Pressure Sensor / Transducer |

R | Radiant Heat Flux | Randomization | RBC | Reactance | Receiver | Recorder | Remote Sensing | Repeatability | Resin | Resistance | Resistivity | Resolution | Reynold's Number |

S | Second | Sensor | Serum | Soft-copy Photogrammetry | Stroke | Stroke-cycle | Systeme Internationale (SI) | SI Base Units SI Derived Units

T | Tag | Telemetry | Thermal Conductivity | Thermistor | Thermocouple | Thermopile | Thrombocytes | Transducer | Transmitter | True North | Turbine

U | Urethane |

V | Velocity | Viscosity | Volt |

W | Watt | Weight | Wheatstone Bridge |

LABB Home | LABB Site map for disability access

In non-relativistic kinematics, acceleration (a) is defined as the derivative of velocity, as described by the equation:

$$\mathbf{a} = \frac{d\mathbf{v}}{dt} = \frac{d^2\mathbf{r}}{dt^2}.$$

In simpler terms, acceleration is a change in rate or direction of motion. Linear acceleration occurs when the rate of motion (speed) along a straight line changes. Centripetal acceleration occurs in circular motion at constant angular velocity as the direction of motion changes. Angular acceleration occurs in circular motion when the rate of rotation changes. Acceleration is the result of a (net) force applied to an object. We can therefore express acceleration in terms of an applied force through this equation derived from Newton's second law:

$$\mathbf{a} = \frac{\mathbf{F}}{m}.$$

The SI unit for acceleration is meter per second squared (m/s^2).

An accelerometer is a device that senses acceleration, typically expressed in m/s^2 or in g-values, with 1 g equal to the acceleration a falling body experiences near the surface of the Earth. Modern accelerometers are typically micro-machined silicon sensors that are based on the capacitive, piezo-resistive or optical detection of the deflection a small mass experiences when the sensors is subjected to acceleration. The accelerometers we use in the LABB are micro-machined, capacitive sensors manufactured by CSEM from silicon wafers in a process similar to the production of integrated circuits.

Most accelerometers are in reality force sensors, and not true sensors of acceleration (as in the change in motion) in the strictest sense. Accelerometers will sense a net force applied to an (accelerating) object. From this force, acceleration can be deducted. As a result of such sensors' sensitivity to force, many respond to the earth's gravitational pull on the sensing mass, in addition to changes in motion. Thus, many accelerometers will deliver a reading of 1g, when the axis of sensitivity is pointing towards the center of the earth (see gravitation).

Accuracy is defined as the sum of errors of hysteresis, repeatability and non-linearity, and is typically expressed as a percentage of full scale output. The accuracy of a measurement is an indication of how close the value of a single measurement is likely to be to the real value (the physical property to be measured). Accuracy depends on a number of parameters, including the resolution of a sensor output digitizing system, if used, repeatability of measurements and hysteresis, as well as how sensitive a measuring system is to changes in other variables. Unfortunately, the term resolution is frequently mistaken for accuracy in digital telemetry. Resolution of a digitizing system is equal to the smallest step in digitized data, or 1 A/D count. Accuracy may depend on the sensor, on stability of the power supply (in terms of supply voltage fluctuations), or on temperature sensitivity of sensor, power supply or A/D conversion circuitry. At best, accuracy of digitizing systems is ± 1 A/D counts, but typically it is closer to ± 2 A/D counts. Measurement accuracy can be experimentally determined by performing multiple measurements under realistic conditions (e.g. not exluding temperature changes for pressure sensors, and by approaching reference depths from lesser and greater depths to include possible hysteresis effects), and calculating the Coefficient of Variation, which can be used as an accuracy figure.

SI unit for Electric Current: ampere [A]
One ampere is defined as the current which if maintained in two parallel wires of infinite length and negligible circular cross-section, which are 1 meter apart in a vacuum, would produce a force of 2 x 10^7 newton per meter of length, between these two conductors.

Measurement by an angle or by degrees of an arc.

The error arc between a bearing line and an estimated location. Also see bearing error.

An archival tag is a recording device that stores (archives) sensor data on some recording medium or in solid state memory for later retrieval. Also called a data recorder.

Argos is a satellite-based location tracking system that also has limited data transfer capability from mobile, Argos compatible transmitters. Access to the Argos system is available as a commercial service by Service Argos Inc. The Argos system was established jointly by the French Space Agency CNES with the U.S. agencies NASA and NOAA. The Argos system operates from receiving platforms located aboard NOAA satellites. Argos-compatible transmitters are available from a variety of manufacturers (see our Links page) for biological and marine applications. Argos tracking accuracy is limited (ranging from +/-0.5 to +/-2.5 km), and data transmission bandwidth is restricted.

The horizontal angle of the observer's bearing in surveying, measured clockwise from a reference direction, as from the north, or from a referent celestial body, usually Polaris.

The angular direction to a landmark or signal source.

The error between the measured bearing and the, usually unknown, actual location of the signal. Also see angular error.

The analysis (through the measurement of) Resistance, Conductance, Impedance and Reactance of biological tissue. Based on empirical findings, BIA assumes a relationship between these measured parameters, and wet tissue mass (lean tissue mass or fat-free mass), or wet-tissue (the electrically conducting tissue) cross-sectional area (perpendicular to flow of electric current). BIA can be used to estimate fat content of a body, or to estimate body condition or body composition. Bioelectric Impedance Analysis is performed by instruments called Plethysmographs.

See our Technology section on Sensors for details on BIA.

Bilirubin is produced in the breakdown of hemoglobin, and carried by plasma to the liver, where it is extracted by hepatic parenchymal cells. It is then conjugated with glucoronide molecule to bilirubin glucoronide, and excreted in the bile. Bilirubin levels are tested as part of the liver function panels.

Biotelemetry is the remote measurement (telemetry) of biologically relevant data, including behavioral, physiological, physical or environmental data.

Blood is the primary transport tissue or organ of the body. It is a tissue comprised of many types of cells and corpuscles (including erythrocytes, see CBC) in a fluid matrix, and may contain fibers. As a result, blood is classically defined as one of the connective tissues! The liquid portion of the blood is called plasma (see also serum). For a listing of the cellular component of blood, see the Complete Blood Count or CBC. Two types of connective tissue produce blood cells: the myeloid tissue and the lymphatic tissue.

Body composition describes of what types of tissue biological organisms are composed. This description can occur at various levels of anatomical or physiological organization. For instance, a body can be described in terms of various types of tissue classes. Such composition is usually based on content by volume or mass. As an example, a body of a dog could be described as being composed of 2 % by mass of skin, 8 % fat, 15 % bones and 20 % of other lean tissue. Lean tissue can be further divided into muscle mass, and the mass of other organs such as liver, lungs etc.. A simple description frequently used in nutritional studies might describe a body by three component classes: % fat, % lean tissue, and % osseous structures. Compare this term to another frequently used and sometimes confusing term: body condition.

In nutritional physiology, body condition is a somewhat vague term that describes the "nutritional condition or status of a body". Most commonly, this is used to describe how well or poorly nourished an animal might be. Since adipose tissue (fat) is usually used to store energy gained from digested food, for subsequent use for energy production, the amount of fat a body stores can be said to reflect body condition. Percent body fat (by mass), as determined by body composition analysis, is frequently used as an indicator of body condition. Other, more indirect indices of body condition have been developed. Most of these indices are more or less indirectly tied to the state of the body fat stores. Mean body density and the ratio of girth to length are examples of condition indices. As an animal becomes less well nourished, previously stored fat is mobilized for energy production. As a result of the depletion of adipose tissue, the mean body density increases (fat has a lower density than lean tissue), or body girth is reduced at a faster rate than body length.

The mass of a body or of an animal, expressed in the SI unit kg (kilograms). (See also

weight)

Bootstrapping - here used in the statistical sense - is a special case of Randomization statistics, where a limited sample of a larger data set is resampled based on the initial sample itself. Without knowing anything else about a sampled population than the sample itself, we can approximate what might happen were the population to be resampled by resampling the sample. In other words, the distribution of the sample from the population is the best descriptor of the distribution in the population itself. The difference to general randomization procedures lies in the fact that elements of the data set treated with randomization procedures are replaced in the random permutations, which is why bootstrapping is also called 'resampling with replacement' vs conventional randomization procedures, which are resampling without replacement. In a special case - the Monte-Carlo Simulation, resampling is acchieved by using an assumed model. Some authors however consider randomization tests as a special case of Monte-Carlo Simulations, where the assumed model is based on complete randomness (all data pairings are equally likely).

The Buffy Coat represents the lymphocyte and platelet fraction of whole blood that is visible as a thin band between the packed red cells and the plasma in a sample of centrifuged whole blood. See the schematic under Packed Cell Volume.

SI unit for Luminous Intensity: candela [cd]
One candela is the luminous intensity of a source that emits monochromatic radiation of frequency 540 × 10^12 hertz and that has a radiant intensity of 1/683 watt per steradian.

Based on changes in capacitance (expressed in units of Farads). For sensors such as accelerometers, capacitive sensing is usually associated with the mechanical displacement of the elements of an electric capacitor, resulting in a change in capacitance. Capacitive sensing is also used in some pressure sensors.

The process of embedding an object (such as the electronics of a recorder) in an embedding medium such as (electrical) resin or epoxy.

The Complete Blood Count (CBC) is one of the most basic diagnostic tests used in clinical hematology for health status assessments. The CBC is comprised of:

- WBC (White Blood Cell or Leukocyte count)
- RBC (Red Blood Cell or Erythrocyte count)
- Hb (Hemoglobin concentration)

- Hct (Hematocrit)
- MCV (Mean Corpuscular Volume)
- MCH (Mean Corpuscular Hemoglobin)
- MCHC (Mean Corpuscular Hemoglobin Concentration)
- RDW (Red Cell Distribution Width, the range of red cell sizes in one blood sample)
- PLT (Platelet count)
- MPV (Mean Platelet Volume)

The CBC with *DIFFERENTIAL* includes a separate listing of the five types of Leukocytes. See also Blood.

Photogrammetry

Three-dimensional photogrammetry uses different perspectives obtained from different images to perform measurements in three-dimensional space, rather than in just two dimensions. Close range photogrammetry is performed on images taken at comparably short distances from the objects of interest, as compared to long-range photogrammetry as performed for examples from airplanes, or even satellites in space, on objects on the ground. In close-range photogrammetry, perspectives from two separate viewpoints (such as our two eyes) converge onto an object, that is the lines connecting each of our eyes to a single point are not parallel. In long-range photogrammetry, the lines connecting two adjacent eyes or cameras to a very distant point are in effect (almost) parallel, they do not apparently converge.

Conductance is the inverse of electrical resistance, expressed in the unit S (Siemens) = A / V where A is the current flow in Amperes and V the potential difference in Volts.

- see Heat Conduction and Heat Flux

Electrical Conductivity

Constraint lines are a relatively novel tool for the analysis of fundamental processes in multivariate systems. Several authors have proposed that fundamental physiological and ecological processes are likely to appear as constraints (or limits) on observed patterns of statistical variation. Such constraints often appear as lines delimiting a scattered field of data points, and some authors have therefore called the observed phenomenon "threshold effects" or "edge effects" which are defined by "boundary conditions". Constraint lines (another descriptor that is sometimes used is "performance envelopes") are used to quantitatively define such limits.
See our section in <**TECHNOLOGY**> and <**ANALYTICAL APPROACHES**> on the use of constraint line analysis for the determination of physiological thresholds.

- see Heat Convection and Heat Flux

The coulomb [C] is the derived SI unit of the quantity of electricity, or electric charge.
1C = 1 s A

Angular direction of travel.

Current (or flow) is defined as the rate of a quantity passing a specified point per unit time. In electricity, the term current refers to the rate at which electric charge passes a specific point per unit time. The electrical current (I) is defined as the derivative of charge (Q) with respect to time (t): $I = dQ/dt$
The SI unit for Electric Current is the ampere.

The inverse of elevation. In the context of biotelemetry, depth relates to the depth in a body of water, and is indicated in (positive) meters. Negative meter distances to the surface of a body of water should only be used in conjunction with elevation (negative depth would really be an elevation above the surface level of the body of water). See the paragraph on pressure for details on the determination of depth via pressure measurements.

The distance-independent relationship between two points in space that specifies the angular position of either with respect to the other.

In simple terms, drag is to fluids what friction is to solids. Drag can be explained in terms of two composite variables: one is the dynamic pressure multiplied by the frontal area of an object experiencing drag, the second is a dimensionless variable, which is a function of Reynold's number:

$$D = 1/2\, \rho\, S U^2 \left(\frac{\rho\, \ell\, U}{\mu} \right)^a$$

The second composite variable - the function of Reynold's number - is the Drag Coefficient C_D:

$$C_D = (Re)^a = f(Re)$$

This yields the following simplified formula for drag:

$$D = 1/2\, C_D\, \rho\, S U^2$$

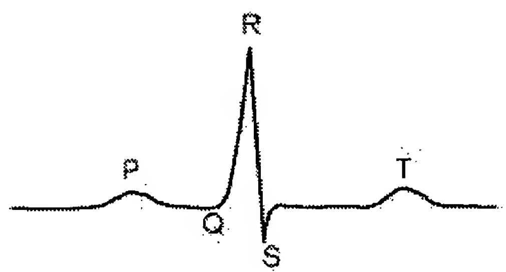
Keep in mind that CD is not a constant! The above formula allows us to work with drag by knowing how the drag coefficient varies with Reynold's number, instead of having to determine how drag varies with size of the object, density, viscosity and speed of the medium.

Recommended reading on drag and flow in biology:

Vogel S (1981) Life in moving fluids - the physical biology of flow. Princeton University Press, Princeton, New Jersey, 352 pp.

- see Drag

An electro-cardio-gram is a recording of the electrical activity of the heart:



The image above shows electric potential on the y-axis (in mV, as detected for example by appropriately placed electrodes, and amplified by a medical ECG unit), as a function of time on the x-axis. The electrical activity of a mammalian heart beat is reflected in five distinct changes in electric potential. A beat starts with the P-wave, which reflects the depolarization of the atrium, followed by the QRS-complex reflecting the ventricular contraction, and concluded in the T-wave, which reflects the repolarization of the ventricle.

Electrical conductivity is the inverse of resistivity, and is defined by the equation:

$$\sigma \equiv \frac{1}{\rho} = \frac{L}{RA}$$

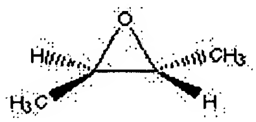
where L is the length of the electrical conductor, R it's resistance, and A it's cross-sectional area (perpendicular to the flow of electrons)

For most metals, electrical conductivity increases with lower temperatures.

- see Current

Electric potential is defined by the amount of work required to move an electric charge. The SI unit for electric potential is the volt [V]. When we say a battery has 1.5 volts, we specify the potential difference of the charges within the battery. In an actual example, when we say that a D-cell has 1.5 volts, this means that for every Coulomb of charge that moves from the negative side of the cell to the positive side, 1.5 joules of work are done. A AA-cell also has

1.5 volts, and once again each charge of 1 coulomb that moves from one side to the other will do 1.5 joules of work. The difference between the D-cell and the AA-cell is that the former has more coulombs worth of charge, and will therefore last longer.



Epoxies are Ep-oxides ("oxygen-on-top"), typically carbon-based organic compounds where an oxygen atom is bound to two adjacent, linked carbon atoms. As a result of the tight binding angles on the oxygen atom epoxides are highly reactive. They are frequently used in multi-component epoxy-based resin-polymer adhesives, which are simply called epoxies.

Erythrocytes are the Red Blood Cells (RBCs) that are specialized for oxygen transport and have a high concentration of the oxygen binding pigment hemoglobin in their cytoplasm. Mammalian erythrocytes are non-nucleated (exceptions exist: camels, lama have nucleated RBCs), whereas avian, reptilian, amphibian and fish erythrocytes do contain nuclei! Rarely, abnormal nucleated erythroid cells may appear in mammalian blood, a condition known as Erythroblastosis. This may be a result of strongly regenerative anaemia. Mammalian erythrocytes also do not contain any organelles. This means they are devoid of mitochondria, and have to meet their energetic demands exclusively through anaerobic glycolysis. Erythrocyte counts (RBC counts) are an important parameter in hematology (see CBC), and are expressed in millions per micro-liter. Normal human values range from 4 to 6 million cells per microliter whole blood. See also MCV (Mean Corpuscular Volume) and RBC.

Oesophagus

see Fix.

The farad [F] is the derived SI unit of the capacitance of an electrical system.
1F = 1 C / V = 1 m^-2 kg^-1 s^4 A^2

The position indicated by the intersection of two or more lines of bearing.

The error distance between the actual location of a signal and the estimated fix. Also can be called "estimate error".

Frequency (f) is the rate at which specific events occur over time. Frequency is defined by

the equation:

$$f = \frac{1}{T} = \frac{\omega}{2\pi}$$ where T is the period (the time between successive occurrences of the specific event), and omega is the angular frequency.

The SI unit for frequency is hertz.

In mechanics and kinematics, a mass is subjected to a force when it's rate or direction of motion changes. Newton's second law states:

$$F = ma$$ (Force equals mass times acceleration for m=const. @ v<<c)

The SI unit for force is the Newton (N, 1N equal to the force required to accelerate a mass of 1 kg at a rate of 1 m/s^2).

g = 9.80665 m/s^2
This is the acceleration an object within the earth's gravitational pull experiences, due to gravity, near the earth's surface.

The determination of the geographical location by geographic coordinates (latitude and longitude) of an object. The location determination can be accomplished by a number of means, including satellite telemetry (see Argos), GPS signal reception, or geolocation by analysis of light levels. For the latter, sunrise and sunset times are determined through the measurement of light levels. Within constraints, the determination of daylength delivers information on latitude, and the determination of sunrise and sunset times (in reference to GMT) delivers information on longitude.

A satellite-based system for the determination of geographical location (see geolocation). Locations are determined in a GPS receiver based on information transmitted from GPS satellites. GPS satellites transmit time-coded data. Distances from receiver to satellites can be computed by the receiver, and from this information location can be calculated. A primary difference to other possible satellite-based geolocation services available for biotelemetry (e.g. Argos) is in the far greater accuracy than most other systems, and in the fact that location data is calculated in the receiver, that is at the site of location of interest, rather than remotely as in the Argos system.

For more detailed information on the Global Positioning System, check out this excellent site hosted by the University of Colorado: Global Positioning System Overview.

Gravitation is one of the four fundamental forces of nature (next to electromagnetism, the weak and strong nuclear forces), and is the force that attracts all objects to one another. The term *Gravitation* typically refers to the force in general, while the term *Gravity* refers to the Earth's gravitational pull.

The SI unit for gravitation is N (Newtons). Objects near the surface of the earth are typically subjected to an acceleration of 1 g, as a result of the gravitational attraction between the object and earth.

The heart rate is typically expressed in beats per minute a heart is beating at. However, while this may sound like a simple matter, there are various definitions of heart rate that differ slightly but significantly. The various terms used include: average heart rate, instantaneous heart rate, true heart rate. When your doctor is measuring the heart rate by looking at the watch and counting the beats during a 15, 30 or 60 second interval, an **AVERAGE HEART RATE** is obtained. Since only whole beats are counted in this method, the method is not very accurate, and the rate obtained does not correspond to the true heart rate. The error is larger with shorter counting intervals. The **TRUE HEART RATE** is the most accurate indication of heart rate. It is obtained by counting both whole and fractional beats during a fixed time interval. Since the counting period is usually not determined by the heartbeats themselves, more than one whole beat is typically counted, and this true heart rate is therefore also an average rate. The **INSTANTANEOUS HEART RATE** is determined by measuring the inter-beat-interval between two successive heartrates. This rate is based on a single interval. The rate is still converted to beats per minute, and such instantaneous heartrates can therefore differ significantly between successive beats (intervals). The instantaneous rate can also be converted to an average value over several successive beats. Such an average heartrate is as accurate as the true heartrate, since only whole beats are counted, but the counting period is adjusted to exclude the possibility of partial beats.

Check out this excellent publication on errors associated with various types of heart rate determinations:
Chabot, D., Bayer, M., and De Roos, A. 1991. Instantaneous heart rates and other techniques introducing errors in the calculation of heart rate. Can. J. Zool. 69: 1117-1120

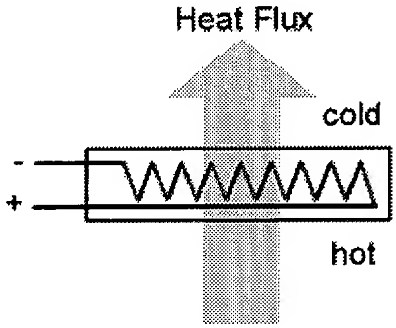
Heat conduction or conductive heat flux is the transport of heat through a solid medium that does not occur by radiation, if the medium is opaque to radiation at the relevant wavelength. The transport of heat through a transparent solid medium can occur by conduction and radiation.

Heat convection, or convective heat flux is the transport of heat in fluids (liquid or gasseous mediums) by means of moving fluids. Convection is often caused by differences in densities, which in turn are caused by differences in temperatures.

The amount of energy flowing through a boundary area per unit time. Frequently, a boundary area of interest is the interface between different media (but not necessarily), examples may include the surface of the body of an animal. Heat flux is expressed in Watts / square meter, and is a vector quantity (it has a direction). The energy flowing through this boundary can be transported by means of heat radiation (in media transparent to the relevant

wavelengths), heat conduction or heat convection. Heat flux can be quantified with heat flux sensors. Heat flux is sometimes also labeled as thermal flux, thermal flow or heat flow. See also thermal conductivity and thermal diffusivity.

Heat flux sensors (HFRs) are used to measure heat flux. HFRs are typically comprised of miniature thermopiles. Thermopiles are arrays of thermocouples, arranged in series to boost the output voltage from the microvolt range typical for thermocouples, to millivolts. All junctions of one type (e.g. copper - constantan) are on one side of the flat sensor disk, and all junctions of the other type (constantan - copper) are on the other side of the disk. Any temperature gradient across the sensor disk therefore produces an output voltage <> 0.



Thus, HFRs consist of serial dissimilar-metal junctions (thermocouples), or of serial semiconductor junctions (Peltier elements). It is important to realize that heat flux sensors invariably affect the very parameter measured. For starters, since HFRs are solid, heat flow is locally converted to a conductive flow. HFRs may also create local deflections of heat flux, as a result of changing thermal conductivity near the flux boundary of interest (resistance error, e.g. if the sensor decreases the thermal conductivity at the boundary, more energy will flow through the sensor-covered boundary than surrounding areas). In addition, the presence of the sensor may affect heat flow within the body or medium on one side of the boundary of interest, and may as a result change the isothermes in that body (deflection error). As a result, for heat flux determinations using HFRs it is important to quantify the effects of the sensors on the thermal properties of the areas of interest, as well as on the heat flow itself. Frequently (but certainly not always), the effects of small, thin sensors can be neglected.

Heat radiation is the transport of thermal energy by longwave electromagnetic radiation. Objects of a given temperature radiate heat. The amount of energy transported by radiation between two spaces or objects depends on the respective temperatures and spectral properties of the objects / spaces.

Heat can be transfered from one space to another (e.g. fom a body to the surrounding air or vice-versa) by means of conduction, convection and radiation. Examples: if you sit down on a cold marble bench, heat is transfered from your body through the clothes to the bench

through conduction, and you incurr a heat loss. If it's a sunny day, at the same time you are absorbing heat from the sun via radiation. If a cool wind is blowing, and your clothing is not very windproof, you are transfering heat to the surrounding air via convection.

The relative volume of blood occupied by erythrocytes (red blood cells). The hematocrit is abbreviated as Hct and expressed in % (volume). Hct differs from PCV or Packed Cell Volume in that the latter is a measured value based on a centrifuged aliquot of whole blood, whereas the Hct is a calculated value obtained by multiplying a red blood cell count (RBC) with the Mean Corpuscular Volume (MCV). Hct is generally regarded as more accurate than the slightly higher PCV, since plasma is trapped between cells during centrifugation. Note however that most hemocytometers (blood cell counters such as coulter counters) do not deliver accurate counts for avian, reptilian, amphibian and fish blood, since their erythrocytes are nucleated (see erythrocytes). A true baseline Hct value may be hard to measure accurately for other reasons: when drawing a blood sample from a subject, a stress response may cause a contraction of the spleen, resulting in a momentary increase in Hct. Hct may also vary dramatically with physical activity. Average Hct values for humans range from 40 to 48 %. Diving animals, and pinnipeds in particular have elevated hematocrits, with some phocid species ranging above 60%. See also CBC (Complete Blood Count).

A "respiratory pigment" in the blood whose primary function is the transport of oxygen. Hemoglobin (abbreviated as Hb) is a 4-subunit globular protein. Hemoglobin concentration is an important parameter in hematology, and is expressed in grams per deci-liter (of whole blood). Hemoglobin is broken down into Bilirubin. Normal human values range from 12 to 17 g / dl. Diving animals frequently have higher Hb values than terrestrial vertebrates, with some species ranging as high as 24 g / dl. See also MCH (Mean Corpuscular Hemoglobin), MCHC (Mean Corpuscular Hemoglobin Concentration) and CBC (Complete Blood Count).

The hertz [Hz] is the derived SI unit of the frequency of a periodic phenomenon. One hertz indicates that one complete cycle of the periodic phenomenon occurs every second.
1Hz = 1 s^-1

Hydrodynamic drag is drag in a liquid fluid, as opposed to a gaseous fluid. There is really no need to distinguish these two, in terms of fluid dynamics. See Drag

Pressure

The maximum difference in sensor output for a particular measurement point, with the first value obtained while increasing the measured parameter from zero and the second while decreasing it from full scale. This maximum difference is typically expressed as a percent of full scale.

In simple terms, (electrical) impedance (I) can be described as the alternating current (AC) equivalent to a direct current's (DC) resistance. Impedance describes the resistance to the alternating flow of electrons in an AC circuit comprised of a variety of elements including resistors, capacitors and inductors. For AC circuits, even simple, straight-wire conductors have properties of resistors and inductors.

Commonly, the term Z is used to describe the *Complex Impedance* of an AC circuit, where Z = V / I. For resistors, Z = R. For capacitors and inductors, this relationship is more complex. Kirchhoff's laws apply to Z. For a complex linear circuit (comprised of resistors, capacitors and inductors) driven by a sinusoidal alternating current, the impedance can be described by this equation:

$I = I_0 \cos(\omega t + \phi)$ where omega is the (angular) frequency, phi is the phase angle, and t is elapsed time.

An impeller is a type of rotor in a turbine where the mechanical, rotary motion of the rotor is created by the impact of the streaming medium onto vanes or cups. In a propeller, the rotary motion is created by a hydrofoil or airfoil effect, rather than by impact. The Pelton turbine is an example of an impeller turbine (also called an impulse turbine). The Kaplan turbine is an example of a propeller turbine.

The angle between any two bearings measured clockwise with their intersection as the origin.

The joule [J] is the derived SI unit of work or energy. One joule is the amount of work done when an applied force of 1 newton moves through a distance of 1 metre in the direction of the force.
1J = 1 N m = 1 m^2 kg s^-2

SI unit for Temperature: kelvin [K]
One kelvin is defined as 1/273.16th of the thermodynamic temperature of the triple point of water.

SI unit for Mass: kilogram [kg]
Mass is the only SI unit not defined by physical properties, but by a standard (an object). One kilogram is defined as the mass of the international prototype of the standard kilogram, a platinum-iridium cylinder kept at Sevres in France. The kilogram is also the only SI unit with a definition inclusive of a prefix (kilo).

Leukoctes are the white blood cells. Their concentration in blood is quantified by the White Blood Cell count (WBC). Normal human WBC values range from about 4000 / ml to 10000 / ml. Leukocytes have vital functions related to the immune system. There are five types of leukocytes, the percentage of which in blood is quantified by the *Differential WBC*: The Granulocytes: Neutrophils, Eosinophils, Basophils; and the Agranulocytes: Monocytes and Lymphocytes. Leukocytes are produced in the bone marrow. See also CBC.

The life history of a species represents the fundamental ecological framework of this species (some call it the fundamental ecological story). Since life history changes in the course of evolutionary processes, life history traits are defined as those traits that have an effect on a species demographic characteristics (natality, mortality, dispersal etc...) and the life history of a species is defined as the summary of traits that affect an organisms timing of reproduction and death.

Life tables are commonly used to predict population trends, based on natality and mortality rates. Originally, the concept of life tables was developed by insurance companies over 100 years ago. Subsequently, ecologists elaborated on this concept to develop more complex life tables for animal species.

For a calibration curve, the maximum deviation from a straight line between zero and full scale. Linearity is typically expressed as a percent of full scale output.

- see Leukocytes

Easterly or westerly angular difference between the direction to the earth's geometric and magnetic poles.

The apparent direction to the earth's magnetic north pole, not usually indicated by a grid on maps. This net magnetic north comprises all the magnetic effects acting on a compass.

A picture or symbol used on a map to represent a landmark or other object.

The quantity of matter contained in an object, as defined by the equation:

$m = \int \rho \, dV$ where m is mass, rho is density, and V is volume.

Mass is a measure of the resistance of an object to change it's state of motion. Mass differs from weight, which is a measure of the gravitational force exerted on an object. Weight is proportional to mass, but varies as a function of distance to and size of the attracting object (earth). An object of a given mass may have a weight of (near) zero in interstellar space. Mass is a property intrinsic to a single object or body, and is expressed in the SI unit kilograms (kg).

Computationally, the Maximum Likelihood Estimator (MLE) determins the most likely value for a function given certain parameter values.

MCH is the acronym for Mean Corpuscular Hemoglobin. MCH refers to the amount of hemoglobin in a single erythrocyte, and is a quantity expressed in [pg] (pico-grams). Normal human values range from 27 to 31 pg / cell. MCH can be calculated as [Hb] / RBC. See also CBC.

MCHC is the acronym for Mean Corpuscular Hemoglobin Concentration. MCHC refers to the average hemoglobin concentration of erythrocytes, and is expressed as [g/dl]. Normal human values range from 32 to 36 g / dl. MCHC can be calculated as (([Hb] / Hct) * 100). See also CBC.

MCV is the acronym for Mean Corpuscular Volume. MCV refers to the typical volume of one erythrocyte. This quantity is expressed in [fl] (femto-liters). Normal human values range from 80 to 100 fl. Abnormal values are referred to as micro- or macro-cythaemia. MCV can be calculated as Hct / RBC. See also CBC.

SI unit for Length: meter [m]
One meter is defined as the distance light travels in 299 792 458 s^-1 in a vacuum.

Exponent	Prefix	Symbol	Multiplier
18	exa	E	1 000 000 000 000 000 000
15	peta	P	1 000 000 000 000 000
12	tera	T	1 000 000 000 000
9	giga	G	1 000 000 000
6	mega	M	1 000 000
3	kilo	k	1 000
2	hecto	h	100
1	deka	da	10
-1	deci	d	0,1
-2	centi	c	0,01
-3	milli	m	0,001
-6	micro	µ	0,00 000 1
-9	nano	n	0,00 000 000 1
-12	pico	p	0,00 000 000 000 1
-15	femto	f	0,00 000 000 000 000 1
-18	atto	a	0,00 000 000 000 000 000 1

Please note that the letter k denotes a factor of 1000, but that capital K is used in computer science to denote a factor of 1024 (2^10), as in 1 Kbyte = 1024 bytes!
See also Systeme International d'Unite (SI measurements).

Note that the correct way in SI to write decimal numbers is to use the comma to separate the fraction from the integer portion of a number, not the point. The use of comma is also inappropriate under SI to divide groups of three adjacent digits in a number for increased readability, although spaces are allowed.
Example: for the number "one million - two hundred thirty six thousand - three hundred ninety eight - decimal zero one" 1,236,398.01 is incorrect, but 1236398,01 and 1 236 398,01 are correct.

acronym for Maximum Likelihood Estimator.

SI unit for Amount of Substance: mole [mol]
One mole is the amount of substance that contains as many elementary entities (atoms, molecules, particles etc..) as there are atoms in 0.012 kg of carbon 12.

A special case of randomization or bootstrap statistics (also called "Resampling with replacement using an assumed model" or "Model-based computation of posterior distributions").

A "respiratory pigment" found primarily in red skeletal muscle, used for oxygen storage. Myoglobin (Abbr. Mb) has a higher affinity for oxygen than hemoglobin at all partial pressures. In capillaries, oxygen is effectively removed from hemoglobin and diffuses into muscle fibers, where it binds to myoglobin, which acts as an oxygen store. Myoglobin is a

single subunit globular protein. Mb is expressed as milligrams Mb per gram wet tissue mass.

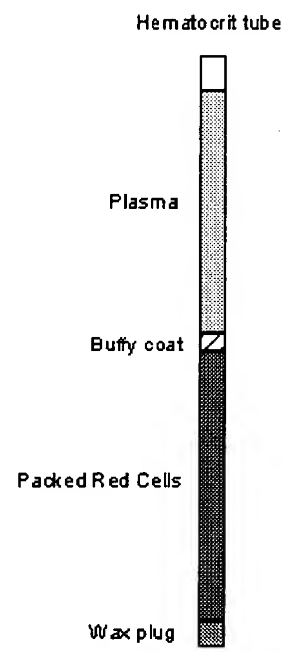
The newton [N] is the derived SI unit of force. One newton is the force required to give a mass of 1 kilogram an acceleration of 1 meter per second squared.
1N = 1 m kg s^-2

see Magnetic North and True North.

The oesophagus is the part of the digestive tract of vertebrates connecting the mouth to the stomach.

The ohm [Greek letter capital omega] is the derived SI unit of resistance of an electrical conductor.
1 ohm = 1 V / A = 1 m^2 kg s^-3 A^-2

The Packed Cell Volume (Abbr. PCV) is defined as the portion of whole blood volume occupied by red blood cells (erythrocytes). PCV has traditionally been determined by measuring the height of the red cell volume in a micro-hematocrit capillary filled with whole blood, after centrifugation (see figure to the right). PCV is a directly measured value, whereas the hematocrit (Hct) is the corresponding calculated value, calculated by multiplying a red blood cell count (RBC count) with the mean erythrocyte volume (MCV). For most practical purposes PCV and Hct are interchangeable (and are frequently used as such by many authors), but typically PCV is slightly higher than the more accurate Hct due to plasma trapping (between the packed cells in a centrifuged capillary). See also hematocrit and Buffy Coat.



The pascal [Pa] is the derived SI unit of pressure. One pascal is the pressure generated by a force of 1 newton acting on an area of 1 square meter.
1Pa = 1 N / m^2 = 1 m^-1 kg s^-2

PIT-Tags or Passive Implantable Transponder Tags are ultraminiaturized radio-transmitters encapsulated in a small glass cyclinder. These tags can be as small as 10 mm long by 2 mm in

diameter. The device does not contain any power source (hence it is "passive"), but is instead energized by the electric current induced in a very small, densely wound coil. To energize a tag, an external alternating electromagnetic field needs to be applied. This is typically done with a handheld or stationary reader or interrogator. This unit contains much larger coils by means of which an alternating current produces an alternating magnetic field which energizes the tag - if it is within the very short range of the field. If a PIT tag is placed in such a field, an electric current is induced in the tag, and the tag becomes activated. An integrated circuit is then used the transmit a very weak radio signal which contains an individual ID code programmed into each PIT tag. This weak radio signal is then detected by the reader / interrogator unit, and displayed. PIT tag systems are used to positively I.D. individual animals implanted with such transponders, in agricultural animals, zoo animals, research animals, and pets.

Photogrammetry is the measurement of physical dimensions from images (photos).

Certain crystals, including quartz, and crystals containing barium titanate and tourmaline, create an electric potential across certain faces under mechanical pressure or distortion. This electric potential results from the displacement of ions in the cryctal lattice in those types of crystals that contain asymmetrical unit cells (the smallest polyhedron comprising the crystalline structure). Conversely, when an external potential is applied to a piezo-electric crystal, mechanical deformation of the crystal results. As a result, piezo-electric crystals have been used in a large variety of electro-mechanical transducers, such as phonographic pick-ups, pressure sensors, and accelerometers.

The piezo-electric effect results in a change in the electrical resistance of a piezo-resistive crystal under mechanical deformation. This effect is used in pressure-transducers which are in turn used in marine telemetry to determine depth by measuring pressure.

The liquid portion of the tissue called blood. See also serum and CBC.

Platelets and Thrombocytes are frequently used synonymously, and refered to as the cytoplasmic cell fragments that play an important role in blood coagulation. They are formed when mega-karyocytes or erythrocyes are fragmenting. Since mammalian erythrocytes are a-karyotic (non-nucleated), the resulting cytoplasmic fragments are also always non-nucleated. Sometimes such fragments are specifically referred to as platelets, to distinguish them from nucleated Thrombocytes. The term thrombocytes is sometimes used to refer specifically to the nucleated cytoplasmic cell fragments in blood from birds, reptiles, amphibians and fishes that are generated from the disintegration of karyotic (nucleated) erythrocytes or mega-karyocytes. Platelets and / or thrombocytes together with lymphocytes make up the Buffy Coat in centrifuged blood. Normal human range from about 150000 to

400000 / ml. See also CBC.

A clinical instrument for performing Bioelectric Impedance Analysis or BIA. Most plethysmographs are fairly large, stationary, AC-powered units, although smaller, portable devices exist. Typically, plethysmographs use four separate electrodes for BIA measurements. Measurements are performed by applying an AC current at frequencies between 5 and 80 kHz, and at rates of 0.8 to 1.0 milli-amperes. Biological tissue impedance, reactance and conductance are then determined by the plethysmograph.

Polyurethanes are polymers with urethane linkages as repeating units. Polyurethanes have excellent electrical properties, a wide range of adjustable flexibilities, extreme toughness and abrasion resistance, high resistance to chemicals, and very low temperature cure. Many urethanes however are sensitive to moisture!

See Urethane

- see Repeatability

Pressure (P) is defined as force (F) per unit area (A): P = F/A.
The SI unit for pressure is the Pascal (Pa), derived as N/m^2. Other non-SI units historically used or still in use for pressure are atmospheres, millimeters or inches of water or mercury, bar, Torr, and psi (pounds per square inch).

At a given depth in a body of a particular fluid, total pressure is equal to the ambient pressure at the surface (P_0), plus the ***hydrostatic pressure***. Hydrostatic pressure is the weight of the fluid column:

$$P_{(force\ per\ unit\ area)} = P_0 + density\ of\ fluid * g * h$$

where h is the height of the fluid column (or depth), and g. is the accelleration due to earth's gravity. Since g varies with distance from the center of the earth, P is defined by an integral function. However, for shallow depths this can usually be neglected.

For freshwater with a density of 1000 kg / m^3, near sea level, hydrostatic pressure can be calculated as a function of depth:

Hydrostatic pressure (kg / m^2) = 1000 (kg/m^3) * 9.80665 (m/s^2) * depth (m).

> ***Example***: at a depth of 10 meters (freshwater):
> Hydrostatic pressure $_{(10m)}$ = 1000 * 9.8 * 10 = 98000 kg / m^2 = 9.8 kg / cm^2 = 960.8 kPa,
> or about 1 atmosphere.

For absolute pressure, ambient pressure at the surface has to be added to hydrostatic pressure.
For highest accuracy at great depths, g needs to be calculated as a function of the distance to

the center of earth.
For saltwater, the greater density of saltwater needs to be accounted for. This may vary with depth! To a very small extent, saltwater density also changes with temperature.

Some pressure conversions:

1 kPa = 1000 N / m^2 = 0.0102 kg / cm^2 = 0.145 lb / in^2

1 atm = 1.03323 kg / cm^2 = 14.696 lb / in^2 = 760 mm mercury = 29.921 in mercury

A device used to measure either absolute pressure, or a pressure differential. Old-fashioned mechanical sensors (such as Bourdon-tubes) have been replaced by modern, solid-state electronic sensors and transducers. The most common modern pressure sensors consist of four piezo-resistive elements arranged in a Wheatstone-Bridge configuration. Such sensors - when connected to a supply voltage - produce an output voltage (bridge voltage) proportional to pressure (differential). Piezo-wheatstone sensors have the inherent disadvantage of a high temperature sensitivity, usually requiring a compensating resistor network for the wheatstone bridge, or micro-processor based compensation calculations. Other modern pressure sensor types include quartz sensors and optical sensors.
Pressure units have varied widely historically, and include mm or inches of water or mercury, atmospheres, psi (pounds per square inch), bar, Torr.
The SI unit for pressure is Pascal (Pa), derived as N/m^2 (force per area).

- see Heat Radiation and Heat Flux

Randomization tests in many ways are the most basic statistical test. A randomization procedure tests for the likelyhood of a given type of pattern to appear in a data set, versus the null hypothesis, which states that the observed pattern has appeared purely by chance in a random set of observations. A randomization test seeks to determine whether the null hypothesis is reasonable in a given data set. For such a test, a test statistic S_t is determined that quantifies an oberved pattern. (e.g. a correlation coefficient). The observed value of S_t is then compared to the distribution of S_t that is obtained, when the data set is reorganized at random. If the null hypothesis is true, then all possible values of S_t are equally likely to occurr. The significance of S_t can be calculated as the proportion of values equally or more extreme than the observed value of S_t.

Randomization has two distinct advantages, and two distinct disadvantages:
Randomization delivers valid significance levels without the random sampling from a larger data set required for the application of 'conventional' statistics, and as a direct consequence randomization procedures are largely exempt from any restrictions that apply to conventional parametric statistics in terms of distibutions.
However, and for the same reason, results from randomization tests cannot directly be extrapolated to a larger, sampled data set; results initially only apply within a complete data set. In addition, small data sets do not directly lend themselves to the calculation of the many permutations needed to accurately obtain reasonable significance levels. This latter

shortcoming can be addressed with special modifications of randomization procedures, Bootstrapping and Monte-Carlo Simulations.

Randomization procedures however are ideally suited for the analysis of large, finite data sets, and in particular for the analysis of telemetered time series data. See our section on **<RANDOMIZATION>** in **<ANALYTICAL PROCEDURES>** under **<TECHNOLOGY>**.

Check out this excellent publication on the topic:
Bryan F.J.Manly (1997) Randomization, Bootstrap and Monte Carlo Methods in Biology (2nd ed.). Texts in Statistical Science. Chapman & Hall, London, UK, 399 pp.

Acronym for Red Blood Cells, or Erythrocytes. The "RBC value", "RBC count" or simply RBC is frequently used to refer to the erythrocyte count, expressed in millions per micro-liter. See erythrocytes.

In electrical engineering, the term reactance is used to describe the frequency-dependence of capacitors and inductors. Put in a simple way, reactance calculates the frequency-corrected values for capacitances and inductances.

Capacitive reactance is defined by the equation: $X_c = 1 / (2 \P f c)$
where f is frequency of an alternating current, and c is the capacitance in farads.

Inductive reactance is defined by the equation: $X_l = 2 \P f l$
where f is the frequency and l is the inductance in henries.

Capacitive reactance and inductive reactance can be converted to equivalent capacitance and inductance values.

A device that collects (receives) information (data) emitted from a transmitter. Typically radio waves, frequently also acoustic waves or optical pulses are used for such data exchange.

Short for data recorder, sometimes also referred to by the type of data recorded, such as Time Depth Recorder, Swimspeed Recorder, Stomach Temperature Recorder, just to name a few. Data recorders measure physical parameters from built-in sensors and record sensor data on some medium, or store data in solid-state memory. Recorders are sometimes also called Archival Tags.

Remote Sensing is telemetry without any physical contact between sensors and the subject of analysis. Most often, the term remote sensing refers to satellite-based collection of data to

map and monitor the environment and resources on Earth.

Repeatability of a measurement - sometimes also called ***precision*** - is an indication of the likelihood of repeatedly obtaining the same result with a measurement system for identical values of measurement parameters. Repeatability is sometimes defined as either exlusive or inclusive of external changes in parameters that might affect the accuracy of a system, such as temperature in a depth recorder. If it is used as an inclusive term, than the range of conditions (e.g. temperature range) affecting the repeatability has to be indicated. The likelihood refers to repeatable results in a series of measurements under constant or defined conditions. Repeatability is expressed as the maximum difference between output readings, as a percentage of full scale.

The term resin is used to describe a class of (semi-) liquid organic substances that are frequently sticky, and can harden into solid substances when exposed to air, ultraviolet radiation, high temperatures, or when combined with a catalyst. Resins are insoluble in water, but soluble in organic solvents in their uncured state. Resins are artificially manufactured, or occur naturally as plant secretions. Amber is fossilized hardened natural resin. Synthetic resins are similar to natural resins. Synthetic resins are frequently used in two-component glue or filler systems, where a synthetic resin is combined with a catalyst to accellerate hardening into an amorphous solid, which is used to bond separate parts. In some adhesives, resins are polymerized.

Resistance is a property of an electrical conductor, and determines how well electrons can flow through this conductor. The SI unit for resistance is the Ohm, where 1 Ohm equals the resistance of a conductor in which a potential difference of 1 volt results in a current flow of 1 ampere. Resistance is defined by the equation:

$$R = \frac{\rho L}{A} = \frac{L}{\sigma A}$$

where rho is the resistivity, L the length, sigma the electrical conductivity, and A the cross sectional area of the electrical conductor (perpendicular to flow of electrons).

Resistivity is the inverse of electrical conductivity and defined by the equation:

$$\rho \equiv \frac{1}{\sigma}$$

Resolution is defined as the smallest discernible step in a measurement system. In digital telemetry systems, this is equal to one A/D conversion step. Resolution should not be (but unfortunately frequently is) confused with accuracy. In digital systems, the resolution can be obtained by dividing the full scale sensor or transducer range by the number of steps delivered by the number of bits of the A/D conversion system. For example, a 12-bit system

is capable of delivering 4096 steps. For a digital depth measuring system with a 1000 m transducer depth span, resolution will be 1000 m / 4096 or about 25 cm. Accuracy will depend on how stable the power supply of the A/D system is, and how well temperature compensated the pressure sensor may be for dealing with ambient pressure changes. The repeatability of measurements will give an indication of how well the data acquisition system will deal with internal variability and produce repeatable results in a series of measurements under constant conditions.

$$\mathrm{Re} = \frac{\rho\, l\, U}{\mu} = \frac{F_I}{F_V}$$

The Reynold's number has been called the centerpiece of biological fluid dynamics. Reynold's number Re is defined as density (of fluid) times length (diameter) times uniform fluid velocity, divided by the dynamic viscosity. The length term used here is a descriptor of the diameter of a pipe for tubular flow, or of the greatest length of a solid in the direction of flow. Reynold's number can also be described as the ratio of inertial forces (Fi) to viscous forces (Fv). Reynold's number is mostly determined by the ratio of dynamic viscosity to density. Reynold's number is dimensionless. See drag. As our dear friend Jon Stern says, "When life gets to be a drag, escape to a higher Reynold's number"!

SI unit for Time: second [s]
One second is defined as the length of time taken for 9 192 631 770 periods of transition between the two ground states of the caesium-133 atom to occur.

A sensor is a device that is responsive (sensitive) to changes in a particular quantity. Examples are physical quantities such as temperature, pressure, motion (acceleration or speed) or biochemical quantities such as a substrate (lactate, glucose) or antibody. In response to changes in the quantity, the sensor changes a property of it's own. Through a transducer, this change can be made visible or converted to a useful format, such as a voltage or current that varies in response to the change in quantity. Frequently a device acts as both sensor and transducer at the same time.

Blood serum is the clear liquid component of blood that separates when blood is allowed to clot completely. Serum is composed of blood plasma, from which fibrinogen has been removed by means of clotting.

In soft-copy photogrammetry, measurements are made not on hard-copy images such as film photos or prints, but on digital or digitized images. Modern computer-based photogrammetry software systems are soft-copy systems.

Here, a stroke is used to define the motion of the flipper or fin of an aquatic animal. A stroke is defined as the motion from the central (relaxed) position of the appendage to one extreme (apex), and back. Such a single stroke is frequently followed immediately by another stroke in the opposite direction. Two such successive strokes in opposite directions combine to form one complete stroke-cycle.

A stroke-cycle consists of two successive strokes by an animals fin or flipper, in opposite directions.

Le Systeme International d'Unites is the international and scientific system of units of measurements, adopted in 1960 (Official Website of the Systeme International). The SI is based upon seven base units, and derived units that are defined by means of the base units. Within SI, prefixes may be used to increase or decrease the sizes of units.

The seven base SI units are:

- SI unit for Length: meter [m]
- SI unit for Mass: kilogram [kg]
- SI unit for Time: second [s]
- SI unit for Electric Current: ampere [A]
- SI unit for Temperature: kelvin [K]
- SI unit for Amount of Substance: mole [mol]
- SI unit for Luminous Intensity: candela [cd]

Examples of SI derived units:

- SI unit for Electric Charge: coulomb [C]
- SI unit for Electric Capacitance: farad [F]
- SI unit for Frequency: hertz [Hz]
- SI unit for Work or Energy: joule [J]
- SI unit for Force: newton [N]
- SI unit for Electrical Resistance: ohm [Greek capital letter omega]
- SI unit for Pressure: pascal [Pa]
- SI unit for Electric Potential: volt [V]
- SI unit for Power or "Rate of doing Work": watt [W]

Note that the correct way in SI to write decimal numbers is to use the comma to separate the fraction from the integer portion of a number, not the point. The use of comma is also inappropriate under SI to divide groups of three adjacent digits in a number for increased readability, although spaces are allowed.
Example: for the number "one million - two hundred thirty six thousand - three hundred ninety eight - decimal zero one" 1,236,398.01 is incorrect, but 1236398,01 and 1 236 398,01 are correct.

Within the Systeme Internationale d'Unites, many units are derived from the base units.
See System International d'Unite

The seven basic units of measurement within the:
System International d'Unite

A tag is used to mark animals. Some of the most commonly used tags are plastic cattle tags, which typically comprise two plastic discs connected by a stem that is punched through a section of skin such as an ear (cattle), or interdigital skin flaps near the base of a flipper (pinnipeds). Leg-bands and wing-bands are commonly used tags on birds. Most tags have numbers or are color-coded for easy identification. Recent high-tech developments include PIT-Tags and Archival Tags.

The term Telemetry stems from two greek words meaning remote (telistos) and measure (metros). Telemetry is remote measurement or the remote collection of data. Telemetered data can be physical, environmental or biological data. Telemetry is typically used to gather data from distant, inaccessible locations, or when data collection would be dangerous or difficult for a variety of reasons. In telemetry, specialized instruments perform measurements of physical quantities, and store or transmit the resulting signal - sometimes after some initial signal processing or conversion.

See also Biotelemetry and Remote Sensing

Property of materials that determines the resistance of the material to the transport of thermal energy. Thermal conductivity is expressed in units of Watts / (meter * Kelvin). Material with a thermal conductivity of 1 W / m.K will allow the transfer of 1 Watt energy across a boundary of 1 square meter, with a temperature gradient of 1 K per meter. Fresh water has a thermal conductivity of 0.6 W/m.K, air has a thermal conductivity of 0.02 W/m.K

Thermistors are semiconductors that exhibit a change in resistance that is proportional to changes in temperature of the semiconductor material. This permits the use of thermistors as effective temperature sensors. Most thermistors have negative temperature coefficients (NTC thermistors, resistance decreases with temperature), although positive coefficient (PTC) thermistors exist. The relationship between resistance and temperature is typically non-linear, but the change in resistance is large for small changes in temperature. Thermistors are frequently used as elements of a Wheatstone Bridge to convert the changes in resistance to changes in voltage, which are more easily digitized. Compared to another frequently used

temperature sensor - the thermocouple - thermistors are far more sensitive, far more accurate, and have a much lower hysteresis. Thermocouples however have a linear output with respect to temperature, and are therefore used for certain applications where linearity is more important than sensitivity or accuracy. Thermocouples are also cheaper and smaller than thermistors.

Thermocouples are junctions of two dissimilar metals that produce a very small voltage proportional to the temperature of the junction. Typically, copper and constantan are metals of choice for thermocouples, although other combinations are frequently used. The voltage of the dissimilar-metal junction can be converted to a temperature when compared to the voltage of a reference junction, typically the connection of the wires to the measuring instrument. This requires the reference junction to be placed at a known temperature (e.g. an ice-water bath), or the use of an "electronic cold point". See also Heat Flux Sensors and thermistors.

- see Heat Flux Sensor

Thrombocytes and Platelets are frequently used synonymously, and refered to as the cytoplasmic cell fragments that play an important role in blood coagulation. They are formed when mega-karyocytes or erythrocyes are fragmenting. Since mammalian erythrocytes are a-karyotic (non-nucleated), the resulting cytoplasmic fragments are also always non-nucleated. Sometimes such fragments are specifically referred to as Platelets, to distinguish them from nucleated thrombocytes. The term thrombocytes is sometimes used to refer specifically to the nucleated cytoplasmic cell fragments in blood from birds, reptiles, amphibians and fishes that are generated from the disintegration of karyotic (nucleated) erythrocytes or mega-karyocytes. Thrombocytes and / or platelets together with lymphocytes form the Buffy Coat in centrifuged blood. See also CBC.

A transducer is a devices that converts the output of a sensor (in response to a change in quantity the sensor is responsive to) into a useful format, typically a voltage or current which changes proportionally to the sensor response.
Examples are pressure transducers. Many industrial pressure transducers utilize piezo-resistive sensor elements, arranged in a Wheatstone Bridge configuration. The piezo-elements change their resistance with pressure (also with temperature, an inherent problem in pressure sensing). Through the wheatstone bridge, pressure-related changes in the sensors' resistance are converted to proportional changes in bridge voltage, when a constant current supply is used.

A device that transmits (emits) information (data) to a receiver. This transmission most typically occurs by means of radio waves, but can also be accomplished through acoustical (ultrasonic) or optical emitters.

The direction to the earth's geographic north pole. Indicated approximately by Polaris, and on maps by degree/minute/second scales and tick marks along the map borders.

A turbine is an engine in which the streaming movement of a medium such as water is converted into the rotary motion of a rotor. This rotary motion is then typically employed to produce mechanical or electrical work.

Urethanes are obtained by reactions of a polyisocyanate with compounds containing two or more hydroxyl groups per molecule (alcohols). Isocyanates contain one or more N=C=O groups. Isocyanate vapours are hazardous!

Basic urethane forming reaction:
R1-NOC + R2-OH ---> R1-NH-CO-O-R2

Frequently, organic compounds with an active hydrogen atom, such as polyester- or amine radicals are used as reactants. By using polyfunctional reactants (compounds with two or more isocyanate groups and compounds with two or more hydroxyl groups) urethane polymers or polyurethanes are obtained.

(Poly)urethanes have excellent electrical properties, a wide range of adjustable flexibilities, extreme toughness and abrasion resistance, high resistance to chemicals, and very low temperature cure. Many urethanes however are sensitive to moisture!

Velocity (v) is defined as the derivative of position with respect to time:

$$\mathbf{v} \equiv \frac{d\mathbf{r}}{dt} = \int \mathbf{a}\, dt.$$

(This applies to non-relativistic movement only, where v<<c)

For linear motion, v can be determined by the equation: $v = v_0 + at$
where v_0 is initial velocity, a is acceleration and t is elapsed time.

Average velocity is defined as: v = x / t
where x is covered distance and t is elapsed time.

Viscosity is a property of fluids, and is comparable to elasticity in solids (see also drag). There are two types of viscosity: kinematic and dynamic.

$$\mu = \frac{F\ell}{US}$$

Dynamic viscosity indicates how much a fluid resists rate of shear, and is

define as Force times distance, divided by uniform fluid speed times (frontal) area. Dynamic viscosity has the dimension of (force)*(time) / (area).

$$\upsilon = \frac{\mu}{\rho}$$

Kinematic viscosity is simply the ratio of dynamic viscosity to density. One can think of dynamic viscosity as the friction or stickiness between a large number of very thin sheets of fluids moving across one another.

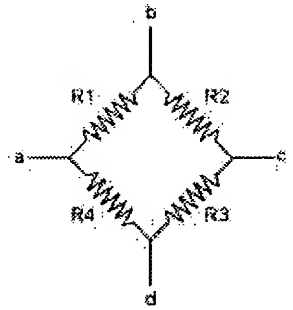
The volt [V] is the derived SI unit of electric potential. One volt is the difference of potential between two points of an electrical conductor when a current of 1 ampere flowing between those points dissipates a power of 1 watt.
1 V = 1 W / A = 1 m^2 kg s^-3 A^-1

The watt [W] is derived SI unit for power or the rate of doing work. One watt is a power of 1 joule per second.
1 W = 1 J / s = 1 m^2 kg s^-3

The weight (w) of an object is a measure of the gravitational force exerted on this object, when within the gravitational pull of another (usually much larger) object. Weight is defined by the equation w = mg, where m is the mass of the object, and g is the acceleration due to gravity.

Weight is quite different from mass. Weight is a force an object experiences in the presence of another mass, whereas mass is a measure of the amount of matter in an object. Weight is not defined as a derived unit in SI. Since weight is a force, the appropriate SI unit would be the Newton (N). Historically, these units have been used for weight: lbs (imperial), kp (kilo-pond, in the cgs system), and many more bizarre units.

The Wheatstone Bridge is named after British inventor Sir Charles Wheatstone, even though the bridge was actually invented by British scientist Samuel Christie. Sir Wheatstone was the first to use this device for its primary modern application: the highly accurate measurement of electrical resistance.



[D] The Wheatstone Bridge consists of four resistors connected in a circular circuit as shown in the diagram to the left. For the classic application of resistance measurement, three of the four resistors are variable resistors of known values. The fourth resistor is unknown. If a bridge voltage is applied from a to c, then the electric current flowing through the bridge is split, flowing through R1 and R2 on one side, and R4 and R3 on the other side. If a voltmeter is connected from b to d, then by adjusting the three known variable resistors until the voltmeter reads zero the bridge can be "balanced", with equal currents flowing through both arms of the bridge. In a balanced bridge the unknown resistance can then be calculated from the values of the known resistances. Check out this fascinating JAVA applet by Doro Wiarda to run an online experiment by measuring an unknown resistance: Wheatstone Bridge Java Applet. In a modification of this application, bridge circuits are frequently used to provide an amplified, highly sensitive output from transducers, by using such transducers as one or more elements of a bridge. The most common application of the Wheatstone Bridge in biotelemetry is the incorporation of four pressure-sensitive piezo-resistive elements into the bridge, for the determination of depth through the measurement of pressure. In such a configuration, a constant current source is applied across a-c. The variable bridge output voltage is then measured from b-d. To maximize bridge output changes as a function of pressure changes, the four piezo-resistive elements of the bridge act in alternating directions: R1 and R3 will decrease resistance, while R2 and R4 will increase resistance, with an increase in pressure. One common problem with this type of pressure-sensor is the temperature sensitivity inherent in most resistors, and in particular in piezo-resistive elements. Two types of remedies are used: external, compensating resistor networks with appropriate temperature coefficients, or a computational compensation of pressure values by applying a complex correction equation to bridge output voltages based on previously measured voltages of individual bridge elements.

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